F/CDD/004
Rev.00.dt.20.03.2020

CURRICULUM AND SYLLABUS
(2022 REGULATION)
(for the students admitted in 2022-23 onwards)

MASTER OF TECHNOLOGY
DESIGN ENGINEERING
(FULL TIME)

DEPARTMENT OF MECHANICAL ENGINEERING

DEPARTMENT VISION

To educate, nurture and motivate the upcoming Engineering professionals with moral and ethical values to become a committed punctilious Engineers to the Nation.

DEPARTMENT MISSION

M1: Providing quality education through well-structured curricula supplemented with Practical training, guest lectures by eminent professionals, field visits to leading industries and also in- plant training.

M2: Enhancing skills through faculty development programme.

M3: Providing ambience for innovative projects and extra-curricular activities

M4: Equipping the department with contemporary infra-structure and the state of art R&D centre to cater to the needs of research scholars and industries

M5: Providing training to students in emerging areas like robotics and CAD/CAM.

M6: Nurturing students having creative ideas to adopt innovative projects which can be subsequently commercialized.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO1: In depth and research based knowledge in design engineering to recognize, inquire, analyze and solve complex engineering design problems.

PEO2: The competencies to work well in local and international team environments and to be effective written and oral communicators.

PEO3: The ability to recognize the importance of, and engage in life-long learning through self study and continuing education

PEO4: Ability to undertake research in emerging areas and to adapt oneself to changing needs of the society considering sustainability as well as societal, environmental and public health aspects.

PROGRAM OUTCOMES

PO1	An ability to independently carry out research investigation and development work to solve practical problems
PO2	An ability to write and present an assignment and report writing.
PO3	An ability to apply knowledge of design concepts to solve engineering problems.
PO4	An ability to identify, select and apply appropriate techniques, resources and design tools to model and analyze engineering design problems.
PO5	An ability to engage in life- long learning for solving design problems taking into consideration sustainability, societal, ethical and environmental aspects..

LIST OF PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Ability to Design and analyze of mechanical components, assemblies and systems

PSO2: Ability to integrate various automation processes for product design and development.

PSO3: Ability to use advanced software tools in design and development of product.

M.Tech: Design Engineering (FT)

Curriculum – 2022 Regulation

(For students admitted in 2022-23 onwards)

SEMESTER I							
Sl. No	**Course Code**	**Course Name**	**Ty/Lb/ IE**	**Teaching Scheme**			**Credits**
				L	**T/SLr**	**P/R**	
1	EMMA22002	Applied Mathematics for Design Engineers	Ty	3	1/0	0/0	4
2	EMDE22001	Computer Aided Design and Manufacturing	Ty	3	0/0	0/0	3
3	EMDE22EXX	Programme Elective1	Ty	3	0/0	0/0	3
4	EMDE22EXX	Programme Elective 2	Ty	3	0/0	0/0	3
5	EMDE22L01	Computer Aided Design Lab –I (Modeling)	Lb	0	0/0	4/0	2
6	EMDE22L02	Rapid Prototyping Lab	Lb	0	0/0	4/0	2
7	EMCC22001	Research Methodology and IPR	Ty	3	0/0	0/0	3
8	EMCC22IXX	AuditCourse1	IE	2	0/0	0/0	0
		Total		**17**	**01**	**8**	**20**

SEMESTER II							
Sl.No.	**Course Code**	**Course Name**	**Ty/Lb/IE**	**Teaching Scheme**			**Credits**
				L	**T/SLr**	**P/R**	
1	EMDE22002	Advanced Finite Element Methods	Ty	3	1/0	0/0	4
2	EMDE22003	Robotics and Sensors	Ty	3	0/0	0/0	3
3	EMDE22EXX	Programme Elective 3	Ty	3	0/0	0/0	3
4	EMDE22EXX	Programme Elective 4	Ty	3	0/0	0/0	3
5	EMDE22L03	Robotics simulation Lab	Lb	0	0/0	4/0	2
6	EMDE22L04	Computer Aided Design Lab –II (Analysis)	Lb	0	0/0	4/0	2
7	EMCC22IXX	AuditCourse-2	IE	2	0/0	0/0	0
8	EMDE22I01	Term paper	IE	0	0/0	0/4	2
		Total		**14**	**01**	**12**	**19**

SEMESTER III							
Sl. No	**Course Code**	**Course Name**	**Ty/Lb/IE**	**Teaching Scheme**			**Credits**
				L	**T/S Lr**	**P/R**	
1	EMDE22004	Mechanical Vibrations	Ty	3	1/0	0/0	4
2	EMDE22EXX	Programme Elective 5	Ty	3	0/0	0/0	3
3	EMOL22I01	Open Elective- **NPTEL/SWAYAM/Any MOOC Approved BY AICTE/UGC**	IE	3	0/0	0/0	3
4	EMDE22I02	Summer Internship	IE	0	0/0	4/0	2
5	EMDE22L05	Dissertation Phase-I	Lb	0	0/0	5/5	5
		Total		**9**	**01**	**14**	**17**

SEMESTER IV							
Sl. No	**Course Code**	**Course Name**	**Ty/Lb/ IE**	**Teaching Scheme**			**Credits**
				L	**T/SLr**	**P/R**	
1	EMDE22L06	Dissertation Phase-II	Lb	0	0/0	10/10	10
2	EMDE22I03	Research Publication	IE	0	0/0	2/2	2
		Total		**0**	**0**	**24**	**12**

ELECTIVES (THEORY)							
S.No	**Sub. Code**	**Title of Subjects**	**Ty/ Lb**	**L**	**T**	**P**	**C**
		PROGRAMME ELECTIVE -1					
1.	EMDE22E01	Advanced Machine Design	Ty	3	0	0	3
2.	EMDE22E02	Design for Manufacturing and Assembly	Ty	3	0	0	3
3.	EMDE22E03	Advanced Stress Analysis	Ty	3	0	0	3
		PROGRAMME ELECTIVE -2					
4.	EMDE22E04	Advanced Material Technology	Ty	3	0	0	3
5.	EMDE22E05	Rapid Prototyping	Ty	3	0	0	3
6.	EMDE22E06	Advanced Mechanism Design	Ty	3	0	0	3
		PROGRAMME ELECTIVE -3					
7.	EMDE22E07	Tribology in Design	Ty	3	0	0	3
8.	EMDE22E08	Computational Fluid Dynamics	Ty	3	0	0	3
9.	EMDE22E09	Creep, Fatigue and Fracture	Ty	3	0	0	3
		PROGRAMME ELECTIVE -4					
10.	EMDE22E10	Design of Material Handling Equipment	Ty	3	0	0	3
11.	EMDE22E11	Artificial Intelligence And Expert Systems	Ty	3	0	0	3
12.	EMDE22E12	Optimization in Engineering Design	Ty	3	0	0	3
		PROGRAMME ELECTIVE -5					
13.	EMDE22E13	Product Design and Development Strategies	Ty	3	0	0	3
14.	EMDE22E14	Product Life Cycle Management	Ty	3	0	0	3
15.	EMDE22E15	Design Thinking and Innovation	Ty	3	0	0	3

AUDIT COURSE 1&2							
Sl.No	**Course Code**	**Course Name**	**Ty/Lb**	**Teaching Scheme**			
				L	**T/SLr**	**P**	**C**
1	EMCC22I01	English for Research paper Writing	Ty	2	0/0	0/0	0
2	EMCC22I02	Disaster Management	Ty	2	0/0	0/0	0
3	EMCC22I03	Sanskrit for Technical Knowledge	Ty	2	0/0	0/0	0
4	EMCC22I04	Value Education	Ty	2	0/0	0/0	0
5	EMCC22I05	Constitution of India	Ty	2	0/0	0/0	0
6	EMCC22I06	Pedagogy Studies	Ty	2	0/0	0/0	0
7	EMCC22I07	Stress Management by Yoga	Ty	2	0/0	0/0	0
8	EMCC22I08	Personality Development through Life Enlightenment Skills	Ty	2	0/0	0/0	0
9	EMCC22I09	Research Publication Ethics	Ty	2	0/0	0/0	0

Summary of Credits:

Semester	Credits
I	**20**
II	**19**
III	**17**
IV	**12**
Total	**68 Credits**

SEMESTER I

Subject Code	Subject Name: APPLIED MATHEMATICS FOR DESIGN ENGINEERS	Ty/ Lb/	L	T/ S.Lr	P/R	C
EMMA22002	Prerequisite: UG level Numerical methods	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

The student should be made to:

- To learn the to find the solution of algebraic equations
- Having problem solving to differential equations.
- Having critical thinking and innovative skills

COURSE OUTCOMES (COs) :

CO1	To be able to understand Functions to find solutions of algebraic equations and Systems of linear equations:
CO2	To Understand the problems and solve the differential equations
CO3	To be able to understand and solve the parabolic equations
CO4	To Derive and use the numerical solution of a given problems by using hyperbolic equations
CO5	To Understand the problem of elliptic equation and solve by numerical methods

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**	**2**	**2**	**3**			
CO2	**3**	**2**	**1**	**2**	**2**			
CO3	**3**	**3**	**1**	**2**	**2**			
CO4	**3**	**2**	**2**	**2**	**1**			
CO5	**3**	**3**	**1**	**2**	**1**			

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
	✓											

Subject Code **EMMA22002**	Subject Name: **APPLIED MATHEMATICS FOR DESIGN ENGINEERS**	**Ty/ Lb/**	**L**	**T/ S.Lr**	**P/R**	**C**
	Prerequisite: UG level Numerical methods	**TY**	**3**	**1/0**	**0/0**	**4**

UNIT I NUMERICAL SOLUTIONS TO ALGEBRAIC EQUATIONS 12

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigen value problems: power method, inverse power method-Faddeev – Leverrier Method.

UNIT II NUMERICAL SOLUTIONS TO DIFFERENTIAL EQUATIONS 12

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, BVP: Shooting method, Direct method, Orthogonal collocation method, Orthogonal collocation with finite element method, Galerkin finite element method.

UNIT III FINITE DIFFERENCE METHODS FOR PARABOLIC EQUATIONS 12

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method.

UNIT IV FINITE DIFFERENCE METHODS FOR HYPERBOLIC EQUATIONS 12

First order hyperbolic equations – method of characteristics, different explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme- Stability of above schemes.

UNIT V FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 12

Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

Total no. of Periods: 60

Reference Books:

1. Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.
2. Gupta S.K., "Numerical Methods for Engineers", New Age Publishers, 1995
3. Burden, R.L., and Faires, J.D., "Numerical Analysis – Theory and Applications", Cengage Learning, India Edition, New Delhi, 2009.
4. Jain M. K., Iyengar S. R., Kanchi M. B., Jain , "Computational Methods for Partial Differential Equations", New Age Publishers,1993.
5. Morton K.W. and Mayers D.F., "Numerical solution of partial differential equations", Cambridge University press, Cambridge, 2002.
6. Sastry S.S., *Introductory Methods of Numerical Analysis*, Prentice Hall of India, (2003).

Subject Code: EMDE22001	Subject Name: COMPUTER AIDED DESIGN AND MANUFACTURING	Ty/ Lb/	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Graphics and Manufacturing Technology	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn

- To expose the basics of computer based modeling
- principles of part programming process planning and product data management

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand various Computer Graphics algorithms and transformation systems
CO2	Apply the knowledge of analytical and geometric form of various curves to solve the engineering design problems
CO3	Modelling of 3D surfaces, wire frames and boundary representation in geometric modeling
CO4	Apply computer aided process planning techniques and modern manufacturing system
CO5	Prepare CNC part programming to perform manufacturing and computer process control.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	1	1	3
CO2	2	1	3	3	1	3	2	3
CO3	1	3	3	3	1	3	2	3
CO4	3	2	3	2	1	1	3	3
CO5	3	2	1	1	1	1	3	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
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Subject Code: EMDE22001	Subject Name: COMPUTER AIDED DESIGN AND MANUFACTURING	Ty/ Lb/	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Graphics and Manufacturing Technology	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION **9**

Definition, Interactive Computer Graphics-Line and Circle plotting algorithm (DDA & Bresenham's), Transformation, Translation, Rotation, Scaling & Mirroring, Concatenated Transformation, Clipping Algorithm, Hidden Line Removal, Explicit and implicit equations, parametric equations.

UNIT II: SPLINES AND CURVES **9**

Cubic Splines-Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form, reparametrization, truncating and subdividing of curves.
Graphic construction and interpretation, composite pc curves. Bezier Curves-Bernstein basis, equations of Bezier curves, properties, derivatives. B-Spline basis, equations, knot vectors, properties, and derivatives.

UNIT III: SURFACES AND SOLIDS **9**

Bi-cubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature. Tri-cubic solid, Algebraic and geometric form.3Dwire frames, Boundary representation, half space modeling, spatial cell, cell decomposition, classification problem.

UNIT IV: PRODUCTION PLANNING AND CONTROL **9**

Group Technology, Computer Aided Process Planning: Retrieval & Generative CAPP, Production Planning, Material Requirement Planning (MRP), mechanism of MRP, benefits, and Capacity Planning. Production Control, Factory Data Collection system, Just-in-Time, Automated Material Handling System, Data Flow in Manufacturing System, Product Data Management System.

UNIT V: COMPUTER NUMERICAL CONTROL **9**

Introduction to NC, Principles and Classifications of CNC, DNC, Part Programming, Adaptive control machining systems, adaptive control optimization system, adaptive control constraint system, applications to machining processes, computer process monitoring, hierarchical structure of computers in manufacturing, and computer process control.

Total No. of Periods: 45

REFERENCES

1. *Ibrahim Zeid, CAD/CAM. Tata McGraw Hill*
2. *Roger and Adams, Elements of Computer Graphics. Tata McGraw Hill*
3. *Micheal Mortenson, E. Geometric Modeling. McGraw Hill Publishers*
4. *Lalit Narayan, K. MallikarjunaRao, K. and Sarcar, M.M.M. Computer Aided Design and Manufacturing, PHI Publishers*

Subject Code: EMDE22L01	Subject Name : COMPUTER AIDED DESIGN LAB-I (MODELING)	Ty/ Lb/	L	T/ S.Lr	P/R	C
	Prerequisite: Engineering Graphics and Finite Element Method	Lb	0	0/0	4/0	2

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn

- To familiarize the students with the working of CAD modelling.
- To make the students aware of design automation and documentation.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the basic concepts of CAD softwares
CO2	Create design using various design software like, CREO, CATIA and solid works.
CO3	Create solid and surface models of mechanical components
CO4	Prepare assembly of various Mechanical components
CO5	Prepare design documentation

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1		2	2	2	1		3
CO2	3		3	3	2	3	2	3
CO3	3		3	3	3	3	1	3
CO4	3		3	3	2	2	2	3
CO5	3		3	3	2	3		3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Audit Course						
				✓								

Subject Code: EMDE22L01	Subject Name : COMPUTER AIDED DESIGN LAB-I (MODELING)	Ty/Lb/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Engineering Graphics and Finite Element Method	Lb	0	0/0	4/0	2
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

I MODELLING:

- Introduction to modeling techniques- Types of modeling- wire frame, surface and solid modeling — Solid modeling - Extrude, Revolve, Sweep, etc and Variational sweep, Loft, etc.
- Generation of surfaces of revolution, surfaces of extrusion, surfaces by skinning operation etc.
- Assembly-Constraints, Exploded Views, Interference check
- Creation of different Mechanical Components like Crank shaft, Connecting rod, Piston and etc. Exercises will be given using packages like CREO/CATIA/ Solid works etc.

Total no. of Periods: 60

Subject Code: EMDE22L02	Subject Name : RAPID PROTOTYPING LAB	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: None	Lb	0	0/0	4/0	2

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn

- To Design and fabricate working models for the conceptual testing applications

COURSE OUTCOMES (COs) : The students will be able to

CO1	Describe the differences and of the application of a range of additive manufacturing processes.
CO2	Optimize the process parameters of FDM machine to improve the quality of the parts produced.
CO3	Build complex engineering assemblies in plastic material with less process planning.
CO4	Improve surface finish of fabricated plastic components for the engineering applications.
CO5	Design and fabricate working models for the conceptual testing applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3
CO2	3	2	3	3	2	3	3	3
CO3	3	2	3	3	2	3	3	3
CO4	3	2	3	3	2	3	3	3
CO5	3	2	3	3	2	3	3	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course						
				✓								

Subject Code: EMDE22L02	Subject Name : RAPID PROTOTYPING LAB	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: None	Ty	0	0/0	4/0	2
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

1. Review of CAD Modeling Techniques and Introduction to RP
2. Forming Groups & Assigning Creative Idea
3. Generating STL files from the CAD Models & Working on STL files
4. Modeling Creative Designs in CAD Software
5. Assembling Creative Designs in CAD Software
6. Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
7. Simulation in Catalyst Software
8. Sending the tool path data to FDM machine
9. Fabricating the physical part on FDM machine
10. Removing the supports & post processing (cleaning the surfaces)
11. Demonstrating Creative Working Models
12. Converting CT/MRI scan data into STL file using MIMICS software (Demo)

Total No. of Periods: 60

Subject Code: EMCC22001	Subject Name : RESEARCH METHODOLOGY AND IPR	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: core subjects	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P : Practical/Project R : Research C: Credits T/L Theory/Lab

OBJECTIVE: The goal is to emphasize the importance of innovation and creativity by understanding the research concepts andethics which will aid to build the nation IPR status.

COURSE OUTCOMES (COs) : By doing this course students will

CO1	Understand research problem formulation by Analyzing research related information and its execution byfollowing research ethics
CO2	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world willbe ruled by ideas, concept, and creativity.
CO3	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted amongstudents in general & engineering in particular.
CO4	Understand that IPR protection provides an incentive to inventors for further research work and investmentin R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
CO5	Drafting of technical patents, registration processes of Rights and Duties of Patentee; Patent infringement; Licensing – Franchising - Joint ventures; Non-Disclosure Agreements (NDAs)

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	2	3	2	2	3	2	2	1
CO2	3	2	1	2	2			2
CO3	3	3	1	2	2		3	1
CO4	3	2	2	2	1	2	3	1
CO5	2	2	2	2	2	2	3	1

3/2/1 indicates Strength of3 Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Subject Code: EMCC22001	Subject Name : RESEARCH METHODOLOGY AND IPR	Ty / Lb	L	T /S.Lr	P/R	C
	Prerequisite: core subjects	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P : Practical/Project R : Research C: Credits T/L Theory/Lab						

UNIT 1: SELECTION, ANALYSIS AND STATEMENT OF THE RESEARCH PROBLEM; 6

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2*: RESEARCH DESIGN* *6*

Types of Study, Types of Data, Measures of Variability, Setting up the Hypotheses, data collection techniques and tools, sampling, Describing data – Charts and graphs ; Data processing – Categorization, coding, summarization.

UNIT 3: DATA ANALYSIS AND REPORT WRITING 6

Statistical measures, Regression and correlation, significance test; Report writing – Purpose, format, content, editing and evaluation. Using Citation tools; Report for specific purposes – Theses, Journals, Grant application. Oral presentation to an audience; use of project management digital tools and plagiarism checking.

UNIT 4: INTRODUCTION TO INTELLECTUAL PROPERTY 6

Types of intellectual property rights – Patent, Copyright, Trade Mark, Industrial Design, Geographical Indication, Trade Secrets - Traditional Knowledge. Elements of Patentability - Novelty, Non Obviousness (Inventive Steps), Industrial Application – Non patentable inventions – Process of patenting – National and International – Form and Fees for IP India

UNIT 5: PRIOR ART SEARCH, PATENT DRAFTING 6

Drafting patent Claims – Types of claims - Registration Procedure, Rights and Duties of Patentee; Patent infringement; Licensing – Franchising - Joint ventures; Non-Disclosure Agreements (NDAs) - Material Transfer Agreements (MTAs).

Total Number of Hours: 30

REFERENCES:

1. *C. Vijayalakshmi and C. Sivapragasam (2011) Research Methods – Tips and Techniques, , MJP Publishers*
2. *Deboraj Rumsey (2010) Statistics Essentials for Dummies, Wiley Publishing Incorporated*
3. *Bouchoux (2013) Intellectual Property, DELMAR CENGAGE Learning, USA*
4. *V K Ahuja (2017) Law Relating to Intellectual Property Rights, LexisNexis Butterworths India*

IMPORTANT WEB LINKS

5. https://www.wipo.int/portal/en/index.html
6. http://ipindia.nic.in/
7. https://www.epo.org
8. https://www.uspto.gov

SEMESTER II

Subject Code: EMDE22002	Subject Name : ADVANCED FINITE ELEMENT ANALYSIS	Ty / Lb	L	T/SLr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials	Ty	3	1/0	0/0	4

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE:
To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Demonstrate the Finite Element formulation for linear problems in plate and shell elements
CO2	Solve the problems of Elasto-Plasticity,Visco plasticity using Iterative Techniques
CO3	Formulate dynamic problems solution in Free, Transient and Forced Response in vibrations
CO4	Solve the Fluid flow and heat transfer problems using FEA
CO5	Estimate the errors while solving the FEA problems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PO3
CO1	2	2	3	2	2	1	3	2
CO2	2	2	3	3	2	2	2	3
CO3	3	2	3	3	1	2	1	2
CO4	3	2	3	3	1	3	2	2
CO5	1	2	1	1	1	1	1	1

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
	✓										

Subject Code: EMDE22002	Subject Name : ADVANCED FINITE ELEMENT ANALYSIS	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: **Engineering Mechanics, Strength of Materials**	Ty	3	1/0	0/0	4
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: BENDING OF PLATES AND SHELLS **12**

Review of Elasticity Equations-Bending of Plates and Shells-Finite Element Formulation of Plate and Shell elements-Conforming and Non Conforming Elements – C0 and C1 Continuity Elements-Application and Examples

UNIT II: NON-LINEAR PROBLEMS **12**

Introduction-IterativeTechniques-Material-non-Linearity-Elasto-Plasticity-Plasticity, Visco plasticity-Geometric Non linearity-large displacement Formulation-Application in Metal Forming Process and contact problems

UNIT III: DYNAMIC PROBLEM **12**

Direct Formulation - Free, Transient and Forced Response - Solution Procedures- Subspace Iterative Technique -Houbolt, Wilson, Newmark - Methods – Examples

UNIT IV: FLUID MECHANICS AND HEAT TRANSFER **12**

Governing Equations of Fluid Mechanics- Inviscid and Incompressible Flow-Potential Formulations-Slow Non-Newtonian Flow-Metal and Polymer Forming-Navier Stokes Equation-Steady and Transient Solutions.

UNIT V: ERROR ESTIMATES AND ADAPTIVE REFINEMENT **12**

Error norms and Convergence rates- high refinement with adaptivity-Adaptive refinement

Total No. of Periods: 60

REFERENCES

1. *Zeinkiewicz, O.C. and Taylor, R. L. (1991) The Finite element Method. Fourth Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics services*
2. *Cook R.D. (1989) Concepts and Applications of Finite Element Analysis. John Wiley & Sons Inc*
3. *Bathe K.J. (1990) Finite Element Procedures in Engineering Analysis. Prentice Hall*

Subject Code: EMDE22003	Subject Name : ROBOTICS AND SENSORS	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: **Nil**	**Ty**	**3**	**0/0**	**0/0**	**3**

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn to understand the basic concepts associated with the design and Functioning and applications of Robots and also study about the drives and sensors used in Robots and learn about analyzing robot kinematics and robot programming

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the Robot motion, drives and applications
CO2	Analyze various kinematic transformation of robot links
CO3	Analyze the Robot control systems and End effectors.
CO4	Create various Robot programming methods
CO5	Evaluate applications of various robot sensors.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3
CO2	3	2	3	3	2	3	3	3
CO3	3	2	3	3	2	3	3	3
CO4	3	2	3	3	2	3	3	3
CO5	3	2	3	3	2	3	3	3

1/2/3 indicates Strength of Correlation 3 High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
		✓									

Subject Code: EMDE22003	Subject Name : ROBOTICS AND SENSORS	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: **Nil**	**Ty**	**3**	**0**	**0**	**3**
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION **9**

Basic concepts-Robot anatomy-robot configurations-Basic Robot motions-Types of drives-Applications-Material Handling-Processing-Assembly and Inspection -Safety considerations.

UNIT II: TRANSFORMATIONS AND KINEMATICS **9**

Vector operations-Translational transformations and Rotational transformations-Properties of transformation Matrices-Homogeneous transformations and Manipulator-Forward solution-Inverse solution

UNIT III: CONTROLS AND END EFFECTORS **9**

Control system concepts-Analysis-control of joints-Adaptive and optimal control-End effectors-Classification-Mechanical-Magnetic-Vacuum-Adhesive-Drive systems-Force analysis and Gripper design

UNIT IV: ROBOT PROGRAMMING **6**

Methods -Languages-Computer control and Robot Software-VAL system and Language

UNIT V: SENSORY DEVICES **12**

Non-optical and optical position sensors-Velocity and Acceleration-Range-Proximity-touch-Slip-Force-Torque-Machine vision-Image components-Representation - Hardware-Picture coding-Object recognition and Categorization-Software consideration- Case Studies

Total No. of Periods: 45

REFERENCES

1. *Fu, K.S. Gonzalez, R. and Lee, C.S.G. (1987) Robotics control, sensing, vision, and Intelligence. McGraw Hill Book Co*
2. *Klafter, R.D. Cmielewski, T.A. and Negin, M. (1994) Robot Engineering an Integrated approach. New Prentice Hall of India*
3. *Deb, S.R. (1994) Robotics Technology and Flexible Automation. Tata McGraw Hill Publishing Co, Ltd*
4. *Craig J.J. (1999) Introduction to Robotics Mechanics and Control. Addison Wesley*
5. *Groover, M.P. (1995) Industrial robotics Technology, programming and applications. McGraw Hill Book Co*
6. *http://www.robotics.com*

Subject Code: EMDE22L03	Subject Name : ROBOTICS SIMULATION LAB	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Robotics and Sensors	Lb	0	0/0	4/0	2

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The student will earn

- **Practical skill in Concepts, design, application and control of robotics and sensors**

COURSE OUTCOMES (COs) : The students will be able to

CO1	Measure and calibrate the static and dynamic responses of a machine structure or machine tool
CO2	Interface different systems for control purpose
CO3	Develop an intelligent system for material handling
CO4	Design and develop a robot for different applications
CO5	Analyze using control systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	2	1	3	3	2	2	3	2
CO2	2	1	3	3	2	2	3	2
CO3	2	1	3	3	2	2	3	2
CO4	2	1	3	3	2	2	3	2
CO5	2	1	3	3	2	2	3	2

1/2/3 indicates Strength of Correlation 3 High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
				✓							

Subject Code: EMDE22L03	Subject Name : ROBOTICS SIMULATION LAB	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Robotics and Sensors	Lb	0/0	0	4/0	2
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

LIST OF EXPERIMENTS

1.Development of strain gauge set up to measure strain in a statically loaded machine structure and calibration of the same.
2. Measurement of damping ratio of a machine tool base from free vibration studies using an impact hammer and an accelerometer pick up with data acquisition system.
3. Interfacing a stepper motor with PC for controlling speed, direction and number of steps using Virtual instrumentation platform.
4. Co-ordinate motion of multiple actuators, electro – pneumatic systems in a desired sequence using Virtual instrumentation platform.
5. Development of an intelligent conveyor system to sort metallic & non-metallic components
6. Development of a pick and place robot
7. Development of an obstacle avoidance robot
8. Development of a path following robot
9. Determining the response time of a control system using PI and PID controllers
10. Determining the positioning accuracy of a linear slide using open loop and closed loop controls

Total No. of Periods: 60

Subject Code: EMDE22L04	Subject Name : COMPUTER AIDED DESIGN LAB-II (Analysis)	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Engineering Graphics and Finite Element Method	Lb	0	0/0	4/0	2

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn

- To acquire the knowledge on analysis of the machine components.
- To understand the concepts of finite element Methods

COURSE OUTCOMES (COs) : The students will be able to

CO1	Design simple models in Ansys.
CO2	Create static and Dynamic analysis.
CO3	Prepare the object in Ansys and perform thermal analysis
CO4	Develop the product and perform mode frequency analysis.
CO5	Prepare a 2D and 3D model and perform heat transfer analysis.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1		2	2	2	1		3
CO2	3		3	3	2	3	2	3
CO3	3		3	3	3	3	1	3
CO4	3		3	3	2	2	2	3
CO5	3		3	3	2	3		3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Audit Course						
				✓								

Subject Code: EMDE22L04	Subject Name : COMPUTER AIDED DESIGN LAB-II (Analysis)	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Engineering Graphics and Finite Element Method	Lb	0	0/0	4/0	2

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn

- To acquire the knowledge on analysis of the machine components.
- To understand the concepts of finite element Methods

COURSE OUTCOMES (COs) : The students will be able to

CO1	Design simple models in Ansys.
CO2	Create static and Dynamic analysis.
CO3	Prepare the object in Ansys and perform thermal analysis
CO4	Develop the product and perform mode frequency analysis.
CO5	Prepare a 2D and 3D model and perform heat transfer analysis.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1		2	2	2	1		3
CO2	3		3	3	2	3	2	3
CO3	3		3	3	3	3	1	3
CO4	3		3	3	2	2	2	3
CO5	3		3	3	2	3		3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Audit Course						
				✓								

Subject Code: MME22DL04	Subject Name : COMPUTER AIDED DESIGN LAB-II (ANALYSIS)	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Engineering Graphics and Finite Element Method	Lb	0	0/0	4/0	2
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

I. ANALYSIS:

- Introduction to FEM-Analysis software's -ANSYS
- Structural and fluid analysis.- One dimensional, Two dimensional and Three dimensional Elements Based Problems.
- Thermal Analysis - Conduction, Convection and Radiation heat transfer Problems.

II. LIST OF EXPERIMENTS

Analysis of Mechanical Components – Use of FEA Packages.

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L bracket.
3. Stress analysis of beams (Cantilever, Simply supported, Fixed ends).
4. Mode frequency analysis of a 2 D component.
5. Thermal stress analysis of a 2D component.
6. Conductive heat transfer analysis of a 2D component.
7. Convective heat transfer analysis of a 2D component

Total no. of Periods: 60

Subject Code: EMDE22I01	Subject Name : TERM PAPER	Ty / Lb/IE	L	T/S.Lr	P/R	C
	Prerequisite: NIL	IE	0	0/0	0/4	2
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

A term paper is an elaborate research-based work on a particular topic in the domain of study. The student must choose a topic of his interest from the domain of study for a term paper. The term paper can be an original research article or review article. In case of review article, the student must refer at least 50 research/review articles and critically review other researcher's work. The term paper may be 10 -20 pages in length. The general guidelines for writing the term paper as follows:

1. Abstract
2. Introduction to explain about the broad and general statement on the topic chosen.
3. Aim /Objective of the term paper.
4. Description of methodology, concepts and arguments.
5. Identify the research gap and suggest possible future works.
6. Conclusion

Three reviews will be conducted to monitor the progress of the work. At the end of the semester, presentation must be made by the student and Viva-Voce examination will be conducted by the Internal Examiner duly appointed by the Head of the department and the students will be evaluated.

SEMESTER III

Subject Code: EMDE22004	Subject Name : MECHANICAL VIBRATIONS	Ty / Lb	L	T /SLr	P/R	C
	Prerequisite: Strength of Materials & Design of Machine Elements	Ty	3	1/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: At the end of this course, the student will • fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions. • be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF). • be able to write the differential equation of motion of vibratory systems.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand fundamental concept of single degree of freedom for forced vibration systems
CO2	Describe the free vibration of spring-coupled system - Mass coupled system for two degrees of freedom
CO3	Evaluate the Eigen-values and mode shapes of natural vibrations of beams and response to harmonic excitations using orthogonal properties of natural modes.
CO4	Determine natural frequencies and mode shapes of MDOF and continuous systems using computational methods
CO5	Gain the Knowledge of various terminologies used in vibration controls.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	2	2
CO2	3	2	3	3	3	3	2	2
CO3	3	2	3	3	3	3	2	2
CO4	3	2	3	3	3	3	2	2
CO5	3	2	3	3	3	3	2	2

1/2/3 indicates Strength of Correlation 1- High, 2- Medium, 3-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships /	Audit Course						
	√											

Subject Code: EMDE22004	Subject Name : MECHANICAL VIBRATIONS	Ty / Lb	L	T /SLr	P/R	C
	Prerequisite: Strength of Materials & Design of Machine Elements	Ty	3	1/0	0/0	3

UNIT I: FUNDAMENALS OF VIBRATION **12**

Review of Single degree freedom systems - Response to arbitrary periodic executions - Duhamel's integral - Impulse response function - Virtual work - Lagrange's equations - Single degree freedom forced vibration with elastically coupled viscous dampers - System identification from frequency response - Transient vibration - Laplace transformation formulation.

UNIT II: TWO DEGREE FREEDOM SYSTEM **12**

Free vibration of spring-coupled system - Mass coupled system - Bending variation of two degree freedom system - Forced vibration - Vibration Absorber - Vibration isolation.

UNIT III: MULTI DEGREE FREEDOM SYSTEM **12**

Normal mode of vibration - Flexibility matrix and stiffness matrix - Eigen value and Eigen vector – Orthogonal properties - Modal matrix - Modal analysis - Forced vibration by matrix inversion - Modal damping in forced vibration - Numerical methods of fundamental frequencies.

UNIT IV: VIBRATION OF CONTINUOUS SYSTEMS **12**

Systems governed by wave equations - Vibration of strings - Vibration of rods - Euler 's equation for beams - Effect of Rotary inertia and shear deformation - Vibration of plates.

UNIT V: VIBRATION CONTROL **12**

Introduction – Reduction of vibration at source- Control of vibration- By structural Design- Material Selection- Located Additions- Artificial Damping- Resilient Isolation, Vibration Isolation- Vibration Absorbers.

Total No. of Periods: 60

REFERENCES

1. *Rao, J. S. & Gupta, K. (1984) Ind. Course on Theory and Practice Mechanical Vibration. New Age International (P) Ltd*
2. *Thomson, W.T. (1990) Theory of Vibration with Applications. CBS Publishers and Distributers*
3. *Den Hartog, J.P. (1990) Mechanical Vibrations. Dover Publications*
4. *Rao, S.S. (1995) Mechanical Vibrations. Addison Wesley Longman*

Subject Code: EMOL22I01	Subject Name : Open Elective (On Line Course through NPTEL/SWAYAM/Any MOOC)	Ty/Lb /IE	L	T/SLr	P/R	C
	Prerequisite: NIL	IE	3	0/0	0/0	3

Students should register for the online course with minimum course duration of 8 weeks through the online portals such as NPTEL/SWAYAM/Any MOOC in the beginning of the semester. The course can be core/interdisciplinary in such a way that the same course is not repeated during the course of his study.

Students are expected to attend the online classes regularly and submit the weekly assignments before the due dates. Students should appear for the online examination and submit the certificate at the end of the semester. Internal examination will be conducted by the examiners duly appointed by the head of the department.

Subject Code: EMDE22I02	Subject Name : SUMMER INTERNSHIP	Ty/Lb /IE	L	T/SLr	P/R	C
	Prerequisite: NIL	**IE**	**0**	**0/0**	**4/0**	**2**

Students are supposed to undergo internship in related Industries for a minimum period of 30 days cumulatively during the semester. They have to prepare a report on the Internship with a certificate in proof from competent authority in the industry. At the end of the semester Viva-Voce examination will be conducted by the Examiners duly appointed by the Head of the department and the students will be evaluated.

Subject Code: EMDE22DL05	Subject Name : DISSERTATION PHASE-I	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: All core papers	Lb	0	0/0	5/5	5
T/L Theory/Lab L: Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

Students should select the area of the project work and complete the literature survey. Student should identify the problem of study and start the work. Students are expected to do the project work individually. A guide will be allotted to each student based on the area of the Project work. Project reviews will be conducted once in a fortnight to assess the development of the project work.

At the end of the semester students should submit a report of the work completed and should appear for a Project Viva- voce examination conducted by the internal examiner.

Continuous assessment mark (50 marks) will be awarded based on the performance in the reviews.

End semester mark (50 marks) will be awarded for project viva voce examination.

SEMESTER IV

Subject Code: EMDE22L06	Subject Name : DISSERTATION PHASE-II	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: All core papers	Lb	0	0/0	10/10	10
T/L Theory/Lab L: Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

Students are expected to do a Project work either in an Industry or at the University in the area of specialization individually. Each student will be allotted a guide based on the area of Project work

Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.

It is mandatory that the student should have presented his project work as a technical paper in National/international conference /Journals. A copy of the certificate in proof of paper presentation should be enclosed in the project report.

50% weightage (100 marks) will be given for the continuous assessment and 50% weightage (100 marks) for the Project viva a voce examination.

Subject Code: EMDE22I03	Subject Name : RESEARCH PUBLICATION	Ty / Lb/IE	L	T/S. Lr	P/R	C
	Prerequisite: All core papers	IE	0	0/0	0/4	2
T/L Theory/Lab L: Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

Students are supposed to prepare and publish the article based on either his term paper or area of research in peer reviewed referred journal. Code of research publication ethics should be followed. After publishing the article students should present a seminar in presence of department faculties and PG students. At the end of semester viva examination will be conducted by the examiners appointed by the Head of the department**.**

PROGRAM ELECTIVE –I

Subject Code: EMDE22E01	Subject Name : ADVANCED MACHINE DESIGN	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Mechanics of Machines-I&II, Design of Machine Elements-I&II	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE:

To study behaviour of mechanical components under fatigue and creep.

To study statistical techniques and its applications in mechanical design

COURSE OUTCOMES (COs) : The students will be able to

CO1	Demonstrate the ability to identify needs of the customer and convert them in to technical specifications of a product
CO2	Understand the creativity, manufacturability, assembly, maintainability, reliability are also important aspects of design other than finding dimensions and stresses.
CO3	Solve problems in unsymmetrical bending and shear center .
CO4	Analyze torsion problems in solid and thin section
CO5	Design the components considering strength based reliability.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	2
CO2	3	2	3	3	2	3	2	2
CO3	3	2	3	3	2	3	2	2
CO4	3	2	3	3	2	3	2	2
CO5	3	2	2	3	2	3	2	2

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course						
		√										

Subject Code: EMDE22E01	Subject Name : ADVANCED MACHINE DESIGN	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Mechanics of Machines-I&II, Design of Machine Elements-I&II	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUTION **9**

Mechanical design process, Phases and interactions of design process, design for sustainability, use of standards and codes in design. Tribological considerations in design, Human factors in design.

UNIT II: DESIGN FOR MANUFACTURING & ASSEMBLY: **9**

Design consideration and recommendation for machining, casting, extrusion, etc. design consideration and recommendation for assembly processes.

UNIT III: UNSYMMETRICAL BENDING AND SHEAR CENTRE: **9**

Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section.

UNIT IV. THEORY OF TORSION: **9**

Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy. Torsion of conical shaft, bar of variable diameter, thin walled members of open cross section in which some sections are prevented from warping, Torsion of noncircular shaft.

UNIT V: DESIGN BASED ON RELIABILITY: **9**

Design for Reliability, strength based reliability, approach to robust design.

Experimental Stress Analysis: Strain gauges, photo elasticity, non-destructive testing, and brittle coating.

Total no. of Periods: 45

REFERENCES:

1. Mechanical Design Process, D G Ullman, McGraw Hill Book Company
2. Design of Machine Elements, V B Bhandari McGraw Hill
3. Design for Manufacturing and Assembly, O Molloy, E A Warman, S Tilley, Springer
4. Advance Strength of Materials, Sandhu Singh, Khanna Publishers
5. Strength of Materials, S S Ratan, McGraw Hill 6. Experimental Stress Analysis, J W Dally, W F Riley, McGraw Hill

Subject Code:	Subject Name : DESIGN FOR MANUFACTURING AND ASSEMBLY	Ty / Lb	L	T/S. Lr	P/R	C
EMDE22E02	Prerequisite: Manufacturing Technology	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn

- Rules and Requirements of designing to ease manufacturing and assembly
- To expose basics of form design
- Manufacturing constraints that influence the design of parts and part systems to understand infeasible or impractical designs
- Assembly considerations and assembly costs in evaluations

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the general aspects of Design for manufacturing and Assembly
CO2	Apply the concept of DFM for casting, forming & machining
CO3	Apply principles of DFA to increase manufacturing efficiency in assembly processes.
CO4	Design/redesign components for casting, forging and machining process.
CO5	Apply Boothroyd method of DFM for product design and assembly.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3		3	3	2	3	1	2
CO2	3		3	3	2	3	1	2
CO3	3		3	3	2	3	1	2
CO4	3		3	3	2	3	1	2
CO5	3		3	3	2	3	1	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course						
		√										

Subject Code:	Subject Name : DESIGN FOR MANUFACTURING AND ASSEMBLY	Ty / Lb	L	T/S. Lr	P/R	C
EMDE22E02	Prerequisite: Manufacturing Technology	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION **9**

General design principles for manufacturability - strength and mechanical factors, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

UNIT II: FORM DESIGN - CASTING **9**

Production methods on form design - Casting considerations - Requirements and rules - Redesign of components for castings and Case studies.

UNIT III: FORM DESIGN – FORGING **9**

Forging considerations - Requirements and rules - Redesign of components for forging and Case studies.

UNIT IV: FORM DESIGN - MACHINING **9**

Machining considerations - Requirements and rules -Redesign of components for Machining and Case studies.

UNIT V: DESIGN FOR ASSEMBLY METHODS **9**

Approaches to design for assembly - Qualitative evaluation procedures, knowledge based approach, Computer aided DFA methods. Assimilability measures. Boothroyd - Dewhurst DFA method - Redesign of a simple product - Case studies.

Total No. of Periods: 45

REFERENCES

1. *Harry Peck, (1983) Design for Manufacture. Pittman Publication*
2. *Alan Redford and Chal, (1994) Design for Assembly - Principles and Procedures. McGraw Hill International*
3. *Robert Matousek, (1963) Engineering Design - A Systematic Approach. Blackie & Sons Ltd*
4. *James G. Bralla, (1986) Hand Book of Product Design for Manufacturing. McGraw Hill Co*
5. *Swift, K.G. (1987) Knowledge Based Design for Manufacture.*

Subject Code: EMDE22E03	Subject Name : ADVANCED STRESS ANALYSIS	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Strength of Materials, Design of Machine elements	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: Ability to analyze plate/shell structures and to solve nonlinear **stress analysis** problems using analytical and finite element techniques.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the theory of elasticity and problem solving methods
CO2	Apply the energy method for analysis of stress, strain and deflection problems
CO3	Determine the effects of torsion in various mechanical elements
CO4	Solve problems in unsymmetrical bending
CO5	Calculate shear center, contact stresses and pressurized cylinders and rotating discs

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	1	3	3	2	3	1	2
CO2	3	1	3	3	2	3	1	2
CO3	3	1	3	3	2	3	1	2
CO4	3	1	3	3	2	3	1	2
CO5	3	1	3	3	2	3	1	2

1/2/3 indicates Strength of Correlation 1- High, 2- Medium, 3-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
		✓									

Subject Code: EMDE22E03	Subject Name : ADVANCED STRESS ANALYSIS	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Strength of Materials, Design of Machine elements	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT 1: THEORY OF ELASTICITY **9**

Theory of Elasticity, Analysis of stress, Analysis of stain, Elasticity problems in two dimension and three dimensions, Mohr's circle for three dimensional stresses. Stress tensor, Air's stress function in rectangular and polar coordinates.

UNIT II: ENERGY METHOD **9**

Energy method for analysis of stress, strain and deflection The three theorem's -theorem of virtual work, theorem of least work, Castiglioni's theorem, Rayleigh Ritz method, Galekin's method, Elastic behavior of anisotropic materials like fiber reinforced composites.

UNIT III: THEORY OF TORSION **9**

Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy. Torsion of conical shaft, bar of variable diameter, thin walled members of open cross section in which some sections are prevented from warping, Torsion of noncircular shaft.

UNIT IV: UNSYMMETRICAL BENDING **9**

Unsymmetrical Bending and Shear Centre Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section.

UNIT V: PRESSURIZED CYLINDERS **9**

Pressurized Cylinders and Rotating Disks Governing equations, stress in thick walled cylinder under internal and external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with variable thickness, disk of uniform strength, Plastic action in thick walled cylinders and rotating disc.

Total no. of Periods: 45

REFERENCES:

1.*Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons, 00*
2. Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/ McGraw Hill 1999
3. Dally, J. W. and W.F. Riley, Experimental Stress Analysis, McGraw Hill International, Third Edition, 1991
4. Theory of Elasticity – Timoshenko and Goodier, Mc Graw Hill
5. Advanced Strength of Materials, Vol. 1,2 – Timoshenko, CBS
6. Advanced Strength of Materials – Den Harteg Advanced Vibrations.

PROGRAMME ELECTIVE –II

Subject Code: EMDE22DE04	Subject Name : ADVANCED MATERIALS TECHNOLOGY	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Engineering Metallurgy	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn

- About different category of materials.
- Materials relevance between alloying, heat treatment and mechanisms influencing , the structure , properties and applications

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand properties and applications of ferrous and nonferrous metals
CO2	Analyze the relevance of alloying and heat treatment of metals
CO3	Explore the basics of newer materials ,like Nano-materials, Bio materials and composites
CO4	Identify the Characteristics and applications of the newer materials
CO5	Understand fission and fusion reactors and evaluate the applications of Nuclear materials.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1		2	1	1	1	1	
CO2	1		2	1	1	1	1	
CO3	1		2	1	1	1	1	
CO4	1		2	1	1	1	1	
CO5	1		2	1	1	1	1	

1/2/3 indicates Strength of Correlation 3 High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
		✓									

Subject Code: EMDE22E04	Subject Name : ADVANCED MATERIALS TECHNOLOGY	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Engineering Metallurgy	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION TO FERROUS MATERIALS. **9**

Plain carbon steels, their properties and application: plain carbon steels, effects of alloying elements in plain carbon steels. Alloy steels, tools steels, stainless steels, low and high temperature resisting steels, high strength steels, selections, specifications, form and availability of steel. Cast irons-white, grey, modular malleable and alloy cast irons. Recognised patterns of distribution of graphite flakes in grey cast iron

UNIT II: NONFERROUS MATERIALS **9**

Ultra light materials. Properties and application, brasses, bronzes, cupro-nickel alloys, aluminium, magnesium and titanium alloys, bearing materials. Heat treatment of nonferrous materials– soputionizing, Aging and precipitations hardening.

UNIT III: NANOMATERIAL **9**

Introduction to Nanomaterials-types-Nano powder-Nanodots-Nanotubes- Nano fluids-Fullerene-Different shape-properties and characteristics and applications. Refractory materials and coatings for high temperature applications. Smart Materials-introduction, types and applications. Thin film shape memory alloys

UNIT IV: BIO-MATERIALS AND COMPOSITES **9**

Classes and application of materials in medicine and dentistry. Stress strain behaviour of bone. The mechanical properties including elasticity, hardness, visco elasticity, surface and fatigue properties of skin; soft tissues; bone; Biocompatible materials and its applications. The effects of degradation and corrosion. Composites-metal, polymers and ceramics- applications

UNIT V: NUCLEAR MATERIALS **9**

Introduction to nuclear materials. Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials. Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers. Radiation proof materials. Brief discussion of safety and radioactive waste disposal.

Total No. of Periods: 45

REFERENCES

1. *Buddy Ratner, D. Hoffman, A.S. and Lemons, J.E. (2004) Biomaterials Science- An Introduction to Materials in*
1. *Medicine. Second Edition, Academic Press*
2. *Joon Park, B. & Lakes Roderic, S. (1992) Biomaterials: An Introduction. Second Edition, Plenum Press*
3. *Edited by Davis, J. R. (2003) Handbook of Materials for Medical Devices. ASM international*
4. *Lamarsh, J.R. Introduction to Nuclear Engineering*
5. *Callister, W.D. Jr, Material Science & Engineering Addition. Wesley Publishing Co*

Subject Code: EMDE22E05	Subject Name : RAPID PROTOTYPING	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Manufacturing Technology, Powder Metallurgy	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn

- Basic Principles of rapid prototyping and its applications in various fields, reverse engineering techniques.
- To familiarize students with different fabrication processes in rapid prototyping systems.
- Mechanical properties and geometric issues relating to specific rapid prototyping applications.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the process of rapid prototyping and its applications
CO2	Apply cad modeling concepts and techniques in RP
CO3	Understand the operating principles, capabilities, and limitations of liquid and solid based RPT systems
CO4	Appreciate the operating principles, capabilities and limitations of powder based RPT systems
CO5	Demonstrate the principles of 3D printing and laser based RP Techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	2		3	3	2	3	3	3
CO2	2		3	3	2	3	3	3
CO3	2		3	3	2	3	3	3
CO4	2		3	3	2	3	3	3
CO5	2		3	3	2	3	3	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
		✓									

Subject Code: EMDE22E05	Subject Name : RAPID PROTOTYPING	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Manufacturing Technology, Powder Metallurgy	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION **8**

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits- Applications.

UNIT II: REVERSE ENGINEERING AND CAD MODELING **10**

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats – Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT III LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, post build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and application. Fused deposition Modeling (FDM): Principles, details of processes, process variables, types, products, materials and applications: Laminated object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications –Case studies.

UNIT IV POWDER BASED RAPID PROTOTYPING SYSTEMS **10**

Selective Laser Sintering (SLS): Principles, process, Indirect and direct SLS – powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Applications. Laser Engineering Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications – Case Studies.

UNIT V OTHER RAPID PROTOTYPING TECHNOLOGIES **7**

Three dimensional Printing (3DP):Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM): Introduction, basic process, shape decomposition, mold SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing.

Total No. of Periods: 45

TEXT BOOKS:

1. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.

REFERENCES:

1. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.

2. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006.
3. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

Subject Code: EMDE22E06	Subject Name : ADVANCED MECHANISM DESIGN	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: **Mechanics of Machines**	**Ty**	**3**	**0/0**	**0/0**	**3**

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: The students will learn methods of kinematic analysis and synthesis of simple mechanisms and basic concepts of spatial mechanisms

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the basic concepts of kinematics and analysis
CO2	Apply the concept of kinematic analysis to find velocity and acceleration of mechanisms
CO3	Study the various methods of synthesis of simple mechanism.
CO4	Formulate the synthesis of various linkages.
CO5	Analyze the spatial mechanisms

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	1	1
CO2	3	2	3	3	2	3	1	1
CO3	3	2	3	3	2	3	1	1
CO4	3	2	3	3	2	3	1	1
CO5	3	2	3	3	2	3	1	1

1/2/3 indicates Strength of Correlation 3 High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
		✓									

Subject Code: EMDE22E06	Subject Name : ADVANCED MECHANISM DESIGN	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: **Mechanics of Machines**	Ty	3	**0/0**	**0/0**	**3**
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION TO KINEMATICS **9**

Review of fundamentals of kinematics--Mobility, kinematic inversion, Graphical position analysis, algegric position analysis, position analysis techniques, displacement difference between two points, rotation and translation, apparent displacement and absolute displacement.

UNIT II: VELOCITY AND ACCELERATON **9**

Velocity and acceleration of simple and complex mechanisms using graphical method.

UNIT III: SYNTHESIS **9**

Type, Number and. Dimensional synthesis - Function generation, path generation, body guidance. Two position synthesis of crank and rocker mechanism. Crank and rocker mechanism with optimum transmission angle. Three position synthesis, Four position synthesis, point precision reduction, precision position, structural error, chebychev spacing.

UNIT IV: SYNTHESIS OF LINKAGES **9**

Coupler curve synthesis, cognate linkages, Robert-Chebychev theorem, Blocks method of synthesis, Freudenstein's equation, Analytical synthesis using complex algebra, Synthesis of dwell mechanisms.

UNIT V: SPATIAL MECHANISM **9**

Introduction, exception in the mobility of mechanisms, the position analysis problem, Velocity and acceleration analysis.

Total No. of Periods: 45

REFERENCES

1. *Sandor, G.N. and Erdman, A.G. (1984) Advanced Mechanism Design Analysis and Synthesis. Prentice Hall*
2. *Shigley, J.E. and Uicker, J.J. (1995) Theory of Machines and Mechanisms. McGraw Hill*
3. *Amitabha Ghosh and Ashok Kumar Mallik, (1999) Theory of Mechanism and Machines. EWLP*
4. *Nortron R.L. (1999) Design of Machinery. McGraw Hill*
5. *Kenneth Waldron, J. and Gary Kinzel, L. (1999) Kinematics, Dynamics and Design of Machinery. John Wiley & sons*

PROGRAMME ELECTIVE – III

Subject Code: EMDE22E07	Subject Name : TRIBOLOGY IN DESIGN	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Engineering Mechanics, Design of Machine Elements-I, Design of Machine Elements-II	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: At the end of this course, the student will be able to understand

- Theories on Friction, Wear and Lubrication
- Surface Engineering and Contact mechanics
- Corrosion and Coatings
- Journal and Rolling Element Bearings

COURSE OUTCOMES (COs) : The students will be able to

CO1	Apply theories of friction and wear to various practical situations
CO2	Understand the various surface measurement techniques and effect of surface texture on tribological behavior of a surface.
CO3	Select materials and lubricants to suggest a tribological solution to a particular situation.
CO4	Design a hydrodynamic bearing using various bearing charts
CO5	Understand the 1-D and 2-D problems by finite difference method.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	1		
CO2	1	1	1	2	1	1		
CO3	1	1	1	2	1	1		
CO4	1	1	1	2	1	1		
CO5	1	1	1	2	1	1		

1/2/3 indicates Strength of Correlation 1- High, 2- Medium, 3-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course						
		√										

Subject Code: EMDE22E07	Subject Name : TRIBOLOGY IN DESIGN	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Design of Machine Elements	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: SURFACES, FRICTION AND WEAR **9**

Topography of the surfaces - Surface features - Surface interaction - Theory of Friction - Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials - friction in extreme conditions - Wear, types of wear - Mechanism of wear - Wear resistance materials - Surface treatment - Surface modifications -Surface coatings.

UNIT II: LUBRICATION THEORY **9**

Lubricants and their physical properties- Viscosity and other properties of oils –Additives and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication
– Hydro static lubrication – Gas lubrication.

UNIT III: DESIGN OF FLUID FILM BEARINGS **9**

Design and performance analysis of thrust and journal bearings - Full, partial, fixed and pivoted journal bearings design - Lubricant flow and delivery - power loss, Heat and temperature, rotating loads and dynamic loads in journal bearings - Hydrostatic Bearing design.

UNIT IV: ROLLING ELEMENT BEARINGS **9**

Geometry and Kinematics - Materials and manufacturing processes - contact stresses - Hertzian stress equation - Load divisions - Stresses and deflection - Axial loads and rotational effects, Bearing life capacity and variable loads - ISO standards - Oil films and their effects - Rolling Bearings Failures.

UNIT V: FINITE DIFFERENCE METHOD **9**

Finite difference approach, Classification of partial differential equations, Parabolic, Hyperbolic and elliptic equations, Discretisations of the 1-Dimensional, 2-Dimensional partial differential equations and its solutions and error and stability analysis, fundamentals of fluid flow modeling.

Total No. of Periods : 45

REFERENCES

1. *Cameron, A. (1981) Basic Lubrication Theory. Ellis Herward Ltd.*
2. *Hulling, J. (Editor), (1984) Principles of Tribology. MacMillan.*
3. *Williams, J.A. (1994) Engineering Tribology. Oxford Univ. Press.*
4. *Neale, M.J. (1995) Tribology Hand Book. Butterworth Heinemann.*
5. *http://www.csetr.org/link.htm*
6. *http://www.me.psu.edu/research/tribology.htm*

Subject Code: EMDE22E08	Subject Name : COMPUTATIONAL FLUID DYNAMICS	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Fluid Mechanics	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: To develop finite volume discretized forms of the governing equations for diffusion• processes. To develop finite volume discretized forms of the convection-diffusion processes.• To develop pressure based algorithms for flow processes.• To introduce various turbulence models, Large Eddy Simulation and Direct Numerical• Simulation.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the governing equations and boundary conditions in Finite different methods
CO2	Analyze various discretization techniques for both steady and unsteady conduction heat transfer problems.
CO3	Analyze the various incompressible flow problems by Finite-Volume method.
CO4	Analyze various discretization techniques for both steady and unsteady convection heat transfer problems
CO5	Select and use the different turbulence models according to the type of flows.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	3
CO2	3	2	3	3	2	3	3	3
CO3	3	2	3	3	2	3	3	3
CO4	3	2	3	3	2	3	3	3
CO5	3	2	3	3	2	3	3	3

1/2/3 indicates Strength of Correlation 1- High, 2- Medium, 3-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course						
		✓										

Subject Code: EMDE22E08	Subject Name : COMPUTATIONAL FLUID DYNAMICS	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Fluid Mechanics	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: GOVERNING DIFFERENTIAL EQUATIONS AND FDM **9**

Classification, Initial and Boundary Conditions, Initial and Boundary value problems. Finite Difference Method, Central, Forward, Backward Difference, Uniform and Non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II: CONDUCTION HEAT TRANSFER **9**

Steady one-dimensional conduction, Two and Three dimensional Steady state problems, Transient One dimensional and Two dimensional problems**.**

UNIT III: INCOMPRESSIBLE FLUID FLOW **9**

Governing Equations, Stream function – Vorticity Method, Determination of Pressure for Viscous flow, Simple procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite Difference Approach**.**

UNIT IV: CONVECTION HEAT TRANSFER AND FEM **9**

Steady One Dimensional and Two Dimensional Convection-Diffusion, Unsteady One Dimensional Convection- Diffusion, Unsteady Two Dimensional Convection – Diffusion – Introduction to Finite Element Method-Solution of Steady Heat Conduction by FEM- Incompressible flow – Simulation by FEM.

UNIT V: TURBULENCE MODELS **9**

Algebraic models –One Equation model, K-I Models, Standard, High and Low Reynolds Number models, Prediction of Fluid flow and Heat transfer using Standard Codes.

Total No. of Periods: 45

REFERENCES

1. Muralidhar, K. and Sundararajan, T. (1995) Computational Fluid Flow and Heat Transfer. Narosa Publishing House
2. Ghoshdasdidar, P.S. (1998) Computer Simulation of Flow and Heat Transfer. Tata McGraw Hill Publishing Company Limited
3. Subhas, V. Patankar, (1980) Numerical Heat Transfer Fluid Flow. Hemisphere Publishing Corporation
4. Taylor, C. and Hughes, J.B. (1981) Finite Element Programming of Navier Stoke Equation. Pine Ridge Press Ltd
5. Anderson, D.A. Tannehill, J.C. and Pletcher, R.H. (1984) Computational Fluid Mechanics and Heat transfer. Hemisphere Publishing Corporation
6. Fletcher, C.A.J. (1987) Computational Techniques for Fluid Dynamics-Fundamental and General Techniques. Springer –Verlag
7. Fletcher, C.A.J. (1987) Computational Techniques for Different Flow Categories. Springer –Verlag
8. Bose T.K. (1997) Numerical Fluid Dynamics. Narosa Publishing House

Subject Code: EMDE22E09	Subject Name : CREEP, FATIGUE AND FRACTURE	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE:
To enhance the knowledge in the areas of failure of engineering structures, failure mechanisms, failure analysis, and failure prevention.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the geometry of stress and strain, elastic deformation, plastic and elastoplastic deformation
CO2	Understand the mechanism of crack formation and its growth
CO3	Demonstrate the mechanics of creep and its stages
CO4	Estimate the fatigue life of a component with or without crack in it.
CO5	Understand the concept of fracture mechanics

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	2	1	2	2	1	2		
CO2	2	1	2	2	1	2		
CO3	2	1	2	2	1	2		
CO4	2	1	2	2	1	2		
CO5	2	1	2	2	1	2		

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course						
		√										

Subject Code: EMDE22E09	Subject Name : CREEP, FATIGUE AND FRACTURE	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Engineering Mechanics, Strength of Materials	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: ELEMENTS OF SOLID MECHANICS **9**

The geometry of stress and strain, elastic deformation, plastic and elastoplastic deformation-limit analysis

UNIT II: CRACK GROWTH **9**

Two dimensional elastic fields-Analytical solutions- Yielding near a crack front-Irwins approximation-plastic Zone size-Dugdaale model-J integral and its relation to crack opening displacement. Griffth analysis-Linear Fracture Mechanics-Crack opening displacement-Dynamic energy balance-crack arrest

UNIT III: CREEP **9**

Mechanics of creep, inter-granular, trans-granular creep, Creep test, Creep strain rate-time curves, Deformation mechanism map; High temperature properties of materials; Long time creep-stress-time relations; Creep contribution to the fracture mechanism; DVM, DVL German-standard, Hatifield time yield test.

UNIT IV: FATIGUE CRACK GROWTH CURVE **9**

Empirical relation describing crack growth by Fatigue-Life calculations for a given load amplitude-effects of changing the load spectrum-Effects of Environment

UNIT V: ELEMENTS OF APPLIED FRACTURE MECHANICS **9**

Examples of crack-growth Analysis for cyclic loading-leak before break- crack initiation under large scale yielding-Thickness as a Design parameter-crack instability in Thermal or Residual-stress fields.

Total No. of periods: 45

REFERENCES

1. *David Broek, (1978) Elementary Engineering Fracture Mechanics. Fifthoff and Noerdhoff International*
1. *Publisher*
2. *Kare Hellan, (1985) Introduction to Fracture Mechanics. McGraw Hill Book Company*
3. *Preshant Kumar, (1999) Elements of Fracture Mechanics. Wheeler Publishing*
4. *Thomas Courtney, H. (2000) Mechanical Behaviour of Materials. 2nd. Ed. Long Grove, Waveland Press, Inc*
5. *William Hosford, F. (2010) Mechanical Behaviour of Materials. 2nd. Ed. Cambridge University Press*
6. *Keith Bowman, Mechanical Behaviour of Materials. John Wiley & Sons*
7. *http://www.elsevier.com/locate/enfracmech*

PROGRAMME ELECTIVE –IV

Subject Code: EMDE22E10	Subject Name : DESIGN OF MATERIAL HANDLING EQUIPMENTS	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Strength of Materials, Mechanics of Machines, Design of Machine Elements	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: At the end of this course, the student will be able to understand

- Fundamental knowledge of Material Handling Equipment.
- Design and analysis of Hoisting Equipment's Like, Rope, Drum, Hook, Chain, Pulley and Girder etc.
- Design of arresting gear, Conveyors and Elevators.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the basic Fundamentals of Material Handling Equipment.
CO2	Design of various hoisting elements like, chains, Hemp and wire ropes, Pulley systems, Sprockets & drums, forged hooks and eye hooks and Girders.
CO3	Design of various hoisting elements like, forged hooks and eye hooks and Girders.
CO4	Design a Conveyors and Selection based on the Application.
CO5	Design of Bucket and Cage Elevator.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	2		3	3	2	3	3	3
CO2	2		3	3	2	3	3	3
CO3	2		3	3	2	3	3	3
CO4	2		3	3	2	3	3	3
CO5	2		3	3	2	3	3	3

1/2/3 indicates Strength of Correlation 1- High, 2- Medium, 3-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
		✓									

Subject Code: EMDE22E10	Subject Name : DESIGN OF MATERIAL HANDLING EQUIPMENTS	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: Strength of Materials, Mechanics of Machines, Design of Machine Elements	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION TO MATERIALS HANDLING EQUIPMENT **9**

Overview - consideration in material handling system design, ten principles of material handling. Types of material handling equipments-trolleys, industrial trucks, AGV, monorails and other rail guided vehicles, conveyors, cranes, hoists and elevators.

UNIT II: DESIGN OF HOISTS **9**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

UNIT III: DRIVES OF HOISTING GEAR **9**

Hand and power drives - Travelling gear - Rail travelling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT IV: CONVEYORS **9**

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT V: ELEVATORS 9

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

Total No. of Periods: 45

NOTE: Use of Approved Data Book is permitted in examination

REFERENCES

1. *Rudenko, N. (1970) Materials handling equipment. ELnvee Publishers*
2. *Mikell Groover, P. (2006) Automation, Production system and computer integrated Manufacturing. Second*
3. *Edition, Prentice Hall of India Pvt. Ltd*
4. *Alexandrov, M. (1981) Materials Handling Equipments. MIR Publishers*
5. *Boltzharol, A. (1958) Materials Handling Handbook. The Ronald Press Company*
6. *P.S.G. Tech, (2003) Design Data Book. Kalaikathir Achchagam*
7. *Lingaiah. K. and Narayana Iyengar, (1983) Machine Design Data Hand Book. Vol.1 & 2, Suma Publishers*
8. *Spivakovsy, A.O. and Dyachkov, V.K. (1985) Conveying Machines. Volumes I and II, MIR Publishers*

Subject Code: EMDE22DE11	Subject Name : ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Computer Aided Design and Manufacturing	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE:

- To study the idea of intelligent agents and search methods.
- To study about representing knowledge.
- To study the reasoning and decision making in uncertain world.
- To construct plans and methods for generating knowledge.
- To study the concepts of expert systems.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Understand the basic concepts of AI and Expert systems
CO2	Apply the knowledge and reasoning in decision making
CO3	Predict the uncertainty using the probability techniques
CO4	Apply various planning and learning strategies
CO5	Understand the importance of expert systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	3	3
CO2	2	2	2	2	3	2	2	3
CO3	2	3	3	2	3	2	2	3
CO4	3	2	3	2	3	2	2	3
CO5	2	2	2	2	3	2	3	3

1/2/3 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
		√									

Subject Code: EMDE22DE11	Subject Name : ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Computer Aided Design and Manufacturing	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I. INTRODUCTION **9**

Introduction to AI: Intelligent agents – Perception –Natural language processing – Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies.

UNIT II KNOWLEDGE AND REASONING **9**

Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents: Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.

UNIT III UNCERTAIN KNOWLEDGE AND REASONING **8**

Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye's rule – Probabilistic reasoning – Making simple decisions.

UNIT IV PLANNING AND LEARNING **9**

Planning: Planning problem – Partial order planning – Planning and acting in non-deterministic domains – Learning: Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active.

UNIT V EXPERT SYSTEMS **10**

Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN.

Total no of periods:45

TEXTBOOKS

1. Stuart Russel and Peter Norvig, 'Artificial Intelligence A Modern Approach', Second Edition, Pearson Education, 2003 / PHI.
2.Donald A.Waterman, 'A Guide to Expert Systems', Pearson Education.

REFERENCE BOOKS

1. George F.Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', Fourth Edition, Pearson Education, 2002.
2. Elain Rich and Kevin Knight, 'Artificial Intelligence', Second Edition Tata McGraw Hill, 1995.

Subject Code: EMDE22E12	Subject Name : OPTIMIZATION IN ENGINEERING DESIGN	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: NIL	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE:
To formulate a formal design optimization problem
To Solve the problem
To Assess and validate solution results

COURSE OUTCOMES (COs) : The students will be able to

CO1	Use Variational principle for optimization
CO2	Apply the dynamic programming to solve problems of discrete and continuous variables.
CO3	Model the real world problem and simulate it.
CO4	Apply the concept of non-linear programming.
CO5	Carry out sensitivity analysis

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	1	1	2
CO2	2	2	3	3	2	1	1	2
CO3	2	2	3	3	2	1	1	2
CO4	2	2	3	3	2	1	1	2
CO5	2	2	2	3	2	1	1	2

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course					
		✓									

Subject Code: EMDE22E12	Subject Name : OPTIMIZATION IN ENGINEERING DESIGN	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: N I L	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: CLASSICAL OPTIMIZATION TECHNIQUES **9**

Single variable optimization with and without constraints, Multi–variable optimization without constraints, multi–variable optimization with constraints– method of Lagrange multipliers, Kuhn-Tucker conditions.

UNIT II: NUMERICAL METHODS FOR OPTIMIZATION **9**

Nelder Mead's Simplex search method, Gradient of a function, steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT III: GENETIC ALGORITHM (GA) **9**

Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA, multi–objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems.

UNITIV: APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS **9**

Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

UNIT V: INTRODUCTION TO NEURAL NETWORKS **9**

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate and- Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch- Pitts Model, Historical Developments, Potential Applications of ANN.

Total No. of Periods: 45

REFERENCES

1. *Jasbir Arora, Optimal design. McGraw Hill (International) Publishers*
2. *Kalyanmoy Deb, Optimization for Engineering Design. PHI Publishers*
3. *Rao, S.S. Engineering Optimization. New Age Publishers*
4. *Johnson Ray, C. (1990) Optimum Design of mechanical elements. John Wiley & Sons*
5. *Kalyanmoy Deb, Multi objective Genetic algorithms. PHI Publishers*
6. *Hertz, Krogh and Palmer, Introduction to the theory of Neural Computation*
7. *Yegnanarayana, B. Artificial Neural Networks. PHI Publishers*
8. David Goldberg, E. (1989) *Genetic Algorithms*. Addison Wesley

PROGRAMME ELECTIVE –V

Subject Code: EMDE22E13	Subject Name :PRODUCT DESIGN AND DEVELOPMENT STRATEGIES	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: NIL	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: At the end of this course, the student will be able to

- Develop, design, manufacture, and test an electromechanical system.
- Hands-on experiences in the interpretation of product/customer specifications, concept development, engineering drawings, design for prototyping, and manufacturing will be utilized in the instruction of the engineering design process.
- Accurately document their product design experience through an engineering notebook.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Describe an engineering design and development process
CO2	Gain the knowledge of creative thinking for quality management
CO3	Analyze the various design consideration in product development
CO4	Apply the various product development strategies in product design
CO5	Understand the design factors in Value engineering

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	2	3
CO2	3	2	3	3	3	3	2	3
CO3	3	2	3	3	3	3	2	3
CO4	3	2	3	3	3	3	2	3
CO5	3	2	3	3	3	3	2	3

1/2/3 indicates Strength of Correlation 1- High, 2- Medium, 3-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course						
		√										

Subject Code: EMDE22E13	Subject Name :PRODUCT DESIGN AND DEVELOPMENT STRATEGIES	Ty / Lb	L	T/S. Lr	P/R	C
	Prerequisite: NIL	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION **9**

Essential factors of product design- requirements of good design- factors affecting product design- product development process tools- Design by evolution and innovation- Asimow's model- Journeys in product development- product engineering – nature and scope- Product design practice in industry.

UNIT II: CREATIVITY **9**

Creative thinking and organizing for product innovation criteria – method and tools for directed creativity – challenges of quality management – Case studies – Mumbai's Dabbawalas – creativity by less learned- Creativity on wheel chair – MARICO (case study)- Patent –design patents- patent application steps – sale of patent rights.

UNIT III: DESIGN CONSIDERATIONS **9**

Functional and production design – form design – influence of basic design, mechanical loading and material on form design – Design for manufacture and assembly – Design for robustness – Design for production – Design for stiffness and rigidity – strength consideration in product design – optimization in design – Project analysis – Mechanical estimating and costing.

UNIT IV: PRODUCT DEVELOPMENT STRATEGIES **9**

Planning and preparation – Resources – Talent –striving, thinking, relating – Quality assurance in product design – Strategy for product development – Case studies.

UNIT V: HUMAN AND VALUE ENGINEERING **9**

Human beings as applicator of forces – Anthropometry – design of controls and displays – man/machine information exchange – aesthetic and ergonomic considerations – Value engineering – maximum value-Normal degree of value – value analysis of job plan – Idea generation check-list – Cost reduction through value engineering case study on tap switch control assembly – Economic factors influencing design – Material and process selection.

Total No. of Periods: 45

REFERENCES

1. *Kavin & Krishn, Product Design Techniques in reverse engineering & New product development, Pearson Education*
1. *Paul Plsek, E. Creativity, Innovation and Quality. Prentice - Hall of India Private Limited*
2. *Jones, J.C. (1970) Design Methods. Interscience*
3. *Buhl, H. (1960) Creative Engineering Design. Iowa State University Press*
4. Dieter, G.E. (1983) *Engineering Design.* McGraw Hill
5. Niebel, B.W. & Draper, A.B. (1974) *Product Design and Process Engineering.* McGraw Hill
6. Harry Peck, (1973) *Designing for Manufacturing.* Sir Issac Pitman and Sons Ltd.

Subject Code: EMDE22E14	Subject Name : PRODUCT LIFE CYCLE MANAGEMENT	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: **Computer Aided Design and Manufacturing**	Ty	3	0/0	0/0	3

T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits

OBJECTIVE: Students can understand **the** product lifecycle management and its applications and the key considerations for a successful product lifecycle management.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Analyze the product life cycle stages and the constraints
CO2	Understand and create the components of typical PDM setup
CO3	Create Work Flow Templates and Integrate them
CO4	Analyze Change Management issues, request, investigation and proposal
CO5	Understand the importance of PLM and corporate challenges

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	2	2	2	2	2			2
CO2	2	2	2	2	2			2
CO3	2	2	2	2	2			2
CO4	2	2	2	2	2			2
CO5	2	2	2	2	2			2

1/2/3 indicates Strength of Correlation 3 - High, 2- Medium, 1-Low

Category	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Audit Course						
		√										

Subject Code: EMDE22E14	Subject Name : PRODUCT LIFE CYCLE MANAGEMENT	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Computer Aided Design and Manufacturing	Ty	3	0/0	0/0	3
T/L/ : Theory/Lab L : Lecture T : Tutorial P :Practical/ Project R : Research C: Credits						

UNIT I: INTRODUCTION **9**

Introduction to Product Data Management (PDM) – Present Market Constraints – Need for Collaboration – Internet and Developments in Server – Client Computing.

UNIT II: COMPONENTS OF PDM **9**

Components of a Typical PDM Setup – Hardware and Software Document Management – Creation and viewing of Documents - Creating Parts – Version and Version Control of Parts and Documents – Case Studies.

UNIT III: CONFIGURATION MANAGEMENT **9**

Base Lines – Product Structure – Configuration Management – Case Studies. Automating Information Flow - Work Flow – Creation of Work Flow Templates - Work Flow Integration.

UNIT IV: CHANGE MANAGEMENT **9**

Change Management: Change Issue – Change Request – Change Investigation – Change Proposal – Change Activity – Case Studies.

UNIT V: IMPORTANCE OF PLM **9**

Emergence of PLM- pre-PLM environment, paradigm, grid- Corporate challenges- service industry in PLM – a challenging project – importance, benefits & applications.

Total No. of Periods: 45

REFERENCES

1. *David Bedworth, Mark Henderson & Philip Wolfe, (1991) Computer Integrated Design and Manufacturing, Tata McGraw Hill Inc*
2. *John Stark, (2011) Product Life Cycle management 21st century paradigm for product realization. 2nd edition, Springer*
3. *Antti Saaksvuori & Anselmi Immonen, (2008) Product life cycle management. 3rd edition, Springer*

Subject Code: EMDE22E15	Subject Name: DESIGN THINKING AND INNOVATION	Ty / Lb	L	T/S. Lr	P/R	C
	Pre requisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial S Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The student will learn

- Solid mechanics of cracked components of different modes by which these components fail under static and fatigue load conditions.

OURSE OUTCOMES (COs) :

CO1	Understand the fundamental concepts of design thinking
CO2	Apply the knowledge of design thinking process in product development
CO3	Innovate the new idea for product creations
CO4	Develop the product design and strategies
CO5	Create a new business idea for a startup.

Mapping of Course Outcomes with Program Outcomes (POs)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2	1	2
CO2	3	2	3	3	2	2	1	2
CO3	3	2	3	3	2	2	1	2
CO4	3	2	3	3	2	2	1	2
CO5	3	2	3	3	2	2	1	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
					✓							

Subject Code: EMDE22E15	Subject Name: DESIGN THINKING AND INNOVATION	Ty/Lb	L	T/S.Lr	P/R	C
	Pre requisite:	Ty	3	0/0	0/0	3

Unit I Introduction to Design Thinking **9**

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking,New materials in Industry.

Unit II Design Thinking Process **9**

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking -person, costumer, journey map, brain storming, product development.Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

Unit III Innovation **9**

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

Unit IV Product Design **9**

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies. Activity: Importance of modeling, how to set specifications, Explaining their own product design.

Unit V Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business –Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes. Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Total No. of Periods: 45

Text Books

1. Change by design, Tim Brown, Harper Bollins (2009)
2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

Reference Books

1. Design Thinking in the Classroom by David Lee, Ulysses press
2. Design the Future, by Shrrutin N Shetty, Norton Press
3. Universal principles of design-William lidwell, kritinaholden, Jill butter.
4. The era of open innovation –chesbrough.

AUDIT COURSE 1 & 2

Subject Code: EMCC22I01	Subject Name ENGLISH FOR RESEARCH PAPER WRITING	Ty / Lb/ IE	L	T/S. Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives

To know the art of writing the research paper and thesis to Ensure the good quality of paper at very first-time submission.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Understand that how to improve your writing skills and level of readability
CO2	Learn about what to write in each section
CO3	Understand the skills needed when writing a Title

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	1	1
CO2	1	1	1	1	1	3	1	1
CO3	1	1	1	1	1	3	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Subject Code: EMCC22I01	Subject Name ENGLISH FOR RESEARCH PAPER WRITING	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0
L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab						

UNIT-I: **4**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II: **4**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III: **4**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV: **4**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT-V: **4**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Total No. of Periods: 20

REFERENCES:

1. *Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)*
2. *Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press*
3. *Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .*
4. *Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011*

Subject Code: EMCC22I02	Subject Name: DISASTER MANAGEMENT	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives: Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multipleperspectives.
CO2	Develop an understanding of standards of humanitarian response and practical relevance in specifictypes of disasters and conflict situations.
CO3	critically understand the strengths and weaknesses of disaster management approaches, planning andprogramming in different countries, particularly their home country or the countries they work in

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	1	1
CO2	1	1	1	1	1	3	1	1
CO3	1	1	1	1	1	3	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities andSocial	Program Core	Program Electives	Open Electives	Practical / Project	Internships /	Soft Skills	Audit course		
										✓		

Subject Code: EMCC22I02	Subject Name: DISASTER MANAGEMENT	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0
L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab						

UNIT-I: INTRODUCTION **4**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II: REPERCUSSIONS OF DISASTERS AND HAZARDS **4**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT-III: DISASTER PRONE AREAS IN INDIA **4**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-IV: DISASTER PREPAREDNESS AND MANAGEMENT **4**

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT-V: RISK ASSESSMENT AND DISASTER MITIGATION **4**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

Total No. of Periods: 20

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Subject Code: EMCC22I03	Subject Name SANSKRIT FOR TECHNICAL KNOWLEDGE	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives To get a working knowledge in illustrious Sanskrit, the scientific language in the world Learning of Sanskrit to improve brain functioning, to develop the logic in mathematics, science & other subjects enhancing the memory power.The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Understanding basic Sanskrit language
CO2	Ancient Sanskrit literature about science & technology can be understood
CO3	Being a logical language will help to develop logic in students

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	1	1
CO2	1	1	1	1	1	3	1	1
CO3	1	1	1	1	1	3	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities andSocial	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills	Audit course		
										✓		

Subject Code: EMCC22I03	Subject Name SANSKRIT FOR TECHNICAL KNOWLEDGE	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0
L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab						

UNIT-I: **8**

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

UNIT-II: **8**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

UNIT-III: **4**

- Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.

Total No. of Periods: 20

SUGGESTED READING

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Subject Code: EMCC22I04	Subject Name VALUE EDUCATION	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives .Understand value of education and self- development, Imbibe good values in students. Let them should knowabout the importance of character

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Knowledge of self-development
CO2	Learn the importance of Human values
CO3	Developing the overall personality

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	1	1
CO2	1	1	1	1	1	3	1	1
CO3	1	1	1	1	1	3	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Subject Code: EMCC22I04	Subject Name VALUE EDUCATION	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0
L : Lecture T : Tutorial	P : Project R : Research C: Credits T/L: Theory/Lab					

UNIT-I: **4**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles.

Value judgments.

UNIT-II: **4**

Importance of cultivation of values. Sense of duty. Devotion, Self- reliance.Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

UNIT-III: **6**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT-IV: **6**

Character and Competence –Holy books Vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Non-violence, Humility, Role of Women.

All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively

Total No. of Periods: 20

SUGGESTED READING

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Subject Code: EMCC22I05	Subject Name : CONSTITUTION OF INDIA	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism To address the role
of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting ofthe Indian Constitution.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to know

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival ofGandhi in Indian politics.
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization ofsocial reforms leading to revolution in India.
CO3	. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adultsuffrage in the Indian Constitution.
CO4	Discuss the passage of the Hindu Code Bill of 1956.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	1	1
CO2	1	1	1	1	1	3	1	1
CO3	1	1	1	1	1	3	1	1
CO4	1	1	1	1	1	3	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities andSocial	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Subject Code: EMCC22I05	Subject Name : CONSTITUTION OF INDIA	Ty / Lb	L	T/S.Lr	P/R	C
	Prerequisite: Nil	Ty	2	0/0	0/0	0
L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab						

UNIT-I: HISTORY OF MAKING OF THE INDIAN CONSTITUTION: **4**
History, Drafting Committee, (Composition & Working)

UNIT-II: PHILOSOPHY OF THE INDIAN CONSTITUTION: **4**
Preamble, Salient Features

UNIT-III: CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES:
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-IV: ORGANS OF GOVERNANCE: **4**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT-V: LOCAL ADMINISTRATION AND ELECTION COMMISSION: **4**
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, **PRI:** Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Total No. of Periods: 20

SUGGESTED READING

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Subject Code: EMCC22I06	Subject Name : PEDAGOGY STUDIES	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives Students will be able to: 4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers. 5. Identify critical evidence gaps to guide the development.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to know

CO1	What pedagogical practices are being used by teachers in formal and informal classrooms in developingcountries?
CO2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and withwhat population of learners?
CO3	How can teacher education (curriculum and practicum) and the school curriculum and guidancematerials best support effective pedagogy?

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	1	1
CO2	1	1	1	1	1	3	1	1
CO3	1	1	1	1	1	3	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities andSocial	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills	Audit course		
										✓		

Subject Code: EMCC22I06	Subject Name : PEDAGOGY STUDIES	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0
L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab						

UNIT I: **4**

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT II: **2**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT III: **4**

Evidence on the effectiveness of pedagogical practices. Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV: **4**

Professional development: alignment with classroom practices and follow- up support, Peer support. Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

UNIT V: **2**

Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Total No. of Periods: 20

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

Subject Code: **EMCC22I07**	**Subject Name: STRESS MANAGEMENT BY YOGA**	**Ty / Lb/ IE**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite : **Basic Knowledge of Yoga**	**IE**	**2**	**0/0**	**0/0**	**0**

- **Objectives**
- To Understand the Basic Concepts of Yoga
- To Gain knowledge on Ashtanga yoga
- To Acquire knowledge of Techniques and Practice of Yogasanas
- To understand stress and the causes. To Attain the knowledge about stress busting through yoga

CO1	Understand the Basic Concepts of Yoga
CO2	Gain knowledge on Ashtanga yoga
CO3	To Understand stress and the causes
CO4	Acquire knowledge of Techniques and Practice of Yogasanas
CO5	Attain the knowledge about stress busting through yoga

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1	1	3	1	1
CO2	1	1	1	1	1	3	1	1
CO3	1	1	1	1	1	3	1	1
CO4	1	1	1	1	1	3	1	1
CO5	1	1	1	1	1	3	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills	Audit course		
										✓		

Subject Code: **EMCC22I07**	**Subject Name: STRESS MANAGEMENT BY YOGA**	**Ty / Lb/ IE**	**L**	**T/S.Lr**	**P/R**	**C**
	Prerequisite : **Basic Knowledge of Yoga**	**IE**	**2**	**0/0**	**0/0**	**0**

UNIT I: **8**

Definitions of Eight parts of yoga. (Ashtanga)

UNIT II: **8**

- Yam and Niyam. Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III: **4**

- Asan and Pranayam

i) Various yog poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayama

Total No. of Periods: 20

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Subject Code: EMCC22I08	Subject Name: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives To learn to achieve the highest goal happily, To become a person with stable mind, pleasing personality anddetermination. To awaken wisdom in student

COURSE OUTCOMES (COs) : At the end of this course the students would be able to know

CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve thehighest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neetishatakam will help in developing versatile personality of students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	1	1
CO2	1	1	1	1	1	3	1	1
CO3	1	1	1	1	1	3	1	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Subject Code: EMCC22I08	Subject Name: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	Ty / Lb/ IE	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

UNIT I: **8**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT II: **8**

- Approach to day to day work and duties.
- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT III: **4**

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Total No. of Periods: 20

SUGGESTED READING

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata

2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,Rashtriya Sanskrit Sansthanam, New Delhi.

Subject Code: EMCC22I09	Subject Name : RESEARCH AND PUBLICATION ETHICS	Ty / Lb/ IE	L	T / S.Lr	P/ R	C
	Prerequisite: core subjects	IE	2	0/0	0/0	2

T/L/ : Theory/Lab L : Lecture T : Tutorial P : Practical/Project R : Research C: Credits T/L Theory/Lab

OBJECTIVE:

- To understand the philosophy of science and ethics, research integrity and publication ethics.
- To identify research misconduct and predatory publications.
- To understand indexing and citation databases, open access publications, research metrics (citations, h-index, impact Factor, etc.).

COURSE OUTCOMES (COs) : By doing this course students will

CO1	Understand the ethical issues related to Research and Publication
CO2	Get to know about different types of plagiarism and ways for avoiding plagiarism
CO3	Know about best practices and guidelines in publication ethics and also learns to avoid Publication misconduct
CO4	Get to know about Violation of publication ethics, authorship and contributor ship and get to identify about Predatory publishers and journals.
CO5	Get to know about various open sources database and research metrics like indexing, citation etc.,

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	3	2	3	3	2	3	2	3
CO2	2	3	3	3	3	2	3	3	2	3	2	3
CO3	2	3	3	3	3	2	3	3	2	3	2	3
CO4	2	3	3	3	3	3	3	3	3	3	3	3
CO5	2	3	3	3	3	2	3	3	2	3	2	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	3
CO2	2	3	3
CO3	2	3	3
CO4	2	3	3
CO5	2	3	3

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Subject Code: EMCC22I09	Subject Name : RESEARCH AND PUBLICATION ETHICS	Ty / Lb/ IE	L	T / S.Lr	P/ R	C
	Prerequisite: Core subjects	IE	2	0/0	0/0	0
T/L/ : Theory/Lab L : Lecture T : Tutorial P : Practical/Project R : Research C: Credits T/L Theory/Lab						

Unit I introduction **4**

Introduction to philosophy: Definition, nature and scope, concept, branches - Ethics: Definition, moralphilosophy, nature of moral judgments and reactions – Ethics with respect to Science and Research Intellectual honesty and research integrity

Unit II: Scientific Conduct **4**

Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)

Redundant Publications: Duplicate and over lapping publications, salami slicing – Selective reportingand misrepresentation of data

Unit III: Publication Ethics –I **4**

Publication ethics: Definition, introduction and importance – Best practices/standards setting initiativesand guidelines: COPE, WAME etc. Publication misconduct: definition, Concept, problems that lead to unethical behavior and vice-versa, types.

Unit IV: Publication Ethics – II **4**

Violation of publication ethics, authorship and contributor ship – Identification of publication misconduct, complaints and appeals – Predatory publishers and journals – Subject specific ethicalissues, Complaints and appeals: examples and fraud from India and Abroad.

Unit V: Data Bases and Research Metrics **4**

Open Access publication and Initiatives – Indexing databases – Citation databases, Web of Science, Scopus, etc. – Impact factor of journals as per Journal Citation report .SNIP, SJR, IPP, Cite Score - Metrics: h-index,gindex,i10index,altmetrics – Conflict of interest.

Total No. of Periods: 20

References:

1. Bird A 2006, Philosophy of Science, Routledge
2. MacIntyre &Alasdair, 1967, A Short History of Ethics, London.
3. Chaddah, P20 1 8, Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN: 9789387480865.
4. On Being a Scientist: A Guide to Responsible Conduct in Research, 2009, National Academy of Sciences, National Academy ofEngineering and Institute of Medicine. 3rd edition, National Academies Press.
5. Resnik, D. B 201 1, what is ethics in research & why is it important. National Institute of Environmental Health Sciences,pp.1—10. https://www.niehs.nih.gov/research/reso_uuces/bioethics/whatis/index.cfm
6. Bcall, J 2012, Predatory publishers are corrupting open access, Nature, Vol. 489, no.7415,pp. 179—179. https://d0i.org/lO.1 03 8/48917%
7. Ethics in Science Education, 2019Indian National Science Academy (INSA), Research and Governance,ISBN: 978-81-939482-1-7. http://www.insaindia.rcs.Wpdf/Ethics_Book.pdf.